185

QUANTIFYING DIFFERENCES IN PASSIVE KNEE LAXITY AND FINITE HELICAL AXIS MEASURES BETWEEN HEALTHY AND ANTERIOR CRUCIATE LIGAMENT DEFICIENT INDIVIDUALS

E.L. Bishop, G. Kuntze, R. Frayne, C. Frank, J. Ronsky. *Univ. of Calgary, Calgary, AB, Canada*

Purpose: Anterior cruciate ligament (ACL) injury increases the risk of developing knee osteoarthritis (OA) with increased joint laxity being seen as a likely contributing factor. Currently there remains a gap in understanding of the relations amongst passive joint joint laxity and dynamic joint stability in healthy and ACL deficient (ACLD) groups. This research quantifies joint laxity using a novel Magnetic Resonance Imaging (MRI) based knee loading apparatus and dynamic joint stability using Motion Analysis (MA) and the Finite Helical Axis (FHA) method. This study quantified the effects of unilateral ACL deficiency on bilateral passive knee laxity and dynamic joint stability. It was hypothesized that: (H1) ACLD individuals would have increased side-to-side differences in laxity and FHA measures compared to healthy, and (H2) ACLD individuals would have larger anterior tibial translation (ATT), and differences in FHA measures in the injured limb compared to healthy.
Methods: Eight healthy females (24 ± 3 yrs) with intact ACLs, and one female with a complete isolated ACL rupture (27 yrs) volunteered for this local ethics board approved study. Subjects performed two dynamic tasks with both legs: unconstrained seated leg swing and single leg squat. Three trials ($n = 3$) per task consisting of five repetitions each were recorded. 3D data for FHA determination were collected from reflective skin markers placed on each lower extremity segment (3 markers/segment) using an 8-camera (120 Hz) video MA system (accuracy $= 0.74 \pm 0.03$ mm). Tracked data were filtered (10 Hz) and analyzed using custom Matlab programs (MathWorks, USA). The FHA was computed over a specified range of knee angles (20-40° flexion). Four parameters described the FHA: location, translation, orientation and dispersion. Location y describes the anterior (+)/posterior (-), and location x distal (+)/proximal (-) position of the FHA in the local coordinate system.
Knee joint geometry images were obtained using a 3T MR scanner and high resolution knee coil (GE, USA). A high resolution sagittal scan captured joint geometry at zero load, and low resolution sagittal scans were performed while anterior loads of 0, 30, 50, 89 and 133 Newtons (N) were applied to the tibia. The femur and tibia were segmented in Amira (VSG, USA). Custom software was used to determine relative displacements of the tibia with respect to the femur between zero and applied loads. Anterior displacement of the tibia at 89N (clinically relevant) was used to describe passive knee laxity.
Normal distribution of healthy data was confirmed using a Kolmogorov-Smirnov test (SPSS, USA). Paired samples t-tests were used to detect differences in passive laxity and knee joint stability between dominant and contralateral legs ($p \leq 0.05$).
Results: No significant differences between legs for the healthy group for ATT or FHA parameters were found, except for location y during the flexion ($p = 0.01$) and extension ($p = 0.02$) phases of the swing task (Table 1).
The ACLD subject showed increased ATT in the injured knee, with a side to side difference of 5.01 mm, compared to 0.49 mm for the healthy group. The ACLD subject had a larger side-to-side difference compared to the healthy group for FHA location x (both tasks), translation (swing), orientation (both tasks), and dispersion (squat). The injured limb of the ACLD subject was located more proximally (loc x) during both tasks, and more anteriorly (loc y) during the squat. During the swing translation decreased, orientation increased, and dispersion decreased. During the squat translation and orientation were similar, and dispersion increased in the ACLD injured limb compared to the healthy group.
Conclusions: The ACLD subject had increased side-to-side difference in ATT (> 3mm indicating ACL rupture), and all FHA parameters for at least one task, supporting H1. Furthermore, increased ATT in the injured limb and differences in FHA parameters between the injured limb and the healthy group were observed, supporting H2. However, additional subjects ($n = 12$) are required to confirm these hypotheses. The swing and squat revealed unique differences in FHA measures between groups, highlighting the importance of testing both open and closed chain tasks.
The study results provide a baseline for healthy side-to-side differences in passive laxity and dynamic stability against which we can compare ACLD individuals. Describing relationships between passive laxity and dynamic stability will enable improved prediction of patient outcomes following an ACL tear, and may play a role in identifying those at high risk of early OA development.

Anterior tibial translation (ATT) and FHA parameters for healthy and ACLD groups

		Healthy					ACL Deficient		
		Dominant		Contralateral		Difference	Non-injured	Injured	Difference
		Mean	Stdev	Mean	Stdev				
ATT (mm)	89N	1.79	0.70	2.28	1.02	0.49	3.05	8.06	5.01
Location x (mm)	Swing flexion	0.85	5.42	1.89	2.45	1.04	-8.19	-4.91	3.28
	Squat flexion	12.84	4.46	11.11	5.10	-1.73	3.10	7.83	4.73
Location y (mm)	Swing flexion	26.67	5.54	22.18	4.75	-4.49	25.84	26.89	1.05
	Squat flexion	22.48	5.68	18.16	4.55	-4.32	29.21	27.73	-1.48
Translation (mm)	Swing flexion	2.01	2.43	2.27	1.55	0.26	1.90	0.44	-1.46
	Squat flexion	3.88	1.28	3.83	1.53	-0.05	4.86	4.41	-0.45
Orientation (degrees)	Swing flexion	12.75	5.71	15.75	5.91	3.00	16.37	23.93	7.56
	Squat flexion	9.75	3.17	12.16	5.85	2.41	3.71	12.77	9.06
Dispersion (degrees)	Swing flexion	1.43	0.66	1.22	0.59	-0.21	1.20	1.01	-0.19
	Squat flexion	1.56	0.23	1.45	0.59	-0.11	1.19	1.75	0.56

186

GAIT AFTER TOTAL KNEE ARTHROPLASTRY: CEMENTED VERSUS CEMENTLESS

M. Zhang, H. Zhan, Y. Cao, B. Chen, G. Du. *Shuguang Hosp. Affiliated to Shanghai Univ. of Traditional Chinese Med., Shanghai, China*

Purpose: Total knee arthroplasty (TKA) is the most common effective intervention for the treatment of end-stage knee osteoarthritis (OA). Based on existing studies most TKA done today are cemented. But recently, some researchers advocated that cementless can be used as an alternative to cemented in TKA. Even if many studies compared the advantages and disadvantages between cemented and cementless, the results were contradictory and the biomechanical differences at the knee were still not clear. The purpose of our study was to determine if the gait patterns differences exist between cemented and cementless TKA and the results may help to determine which fixation type can be made therapy protocol.
Method: The subjects were twenty-eight patients with unilateral osteoarthritis of the knees who were operated on with cemented TKA (average age 70.4±5.4), and twenty seven subjects with same complaint who were operated on with cementless TKA (average age 71.4±5.0). Patients underwent three dimensional gait analysis before and six months after operation by using Vicon Gait Analysis system (Vicon 612, Oxford, UK) and a walkway with two force platforms (Kistler 9286B, Alton, UK). Besides, the visual analog scales for pain were also completed by subjects.
Results: Results are showed in Table 1. Both cemented and cementless groups showed decreased loading pattern (1st, 2nd knee adduction